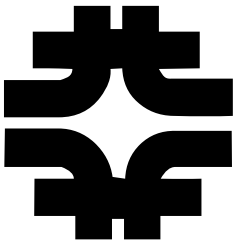
On Luminosity Efficiency.



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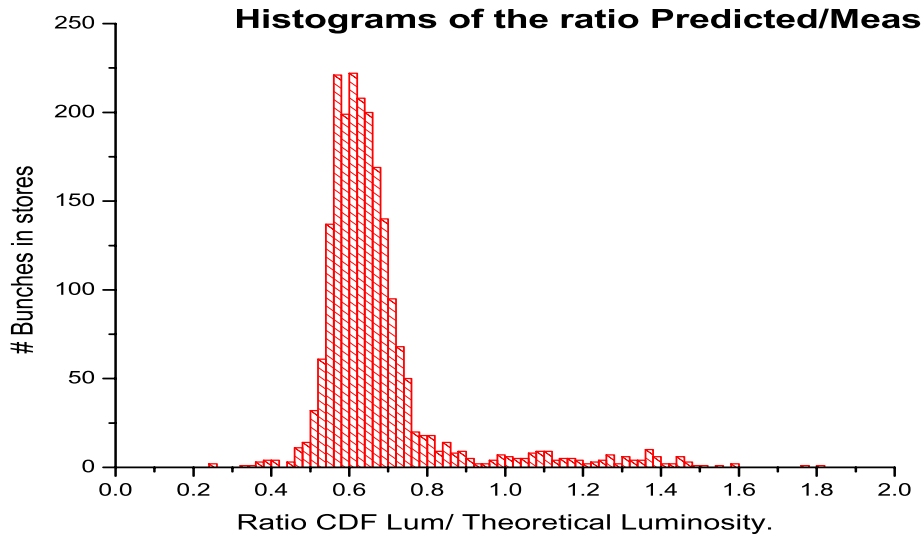
Luminosity, simple theoretical prediction
Luminosity Efficiency

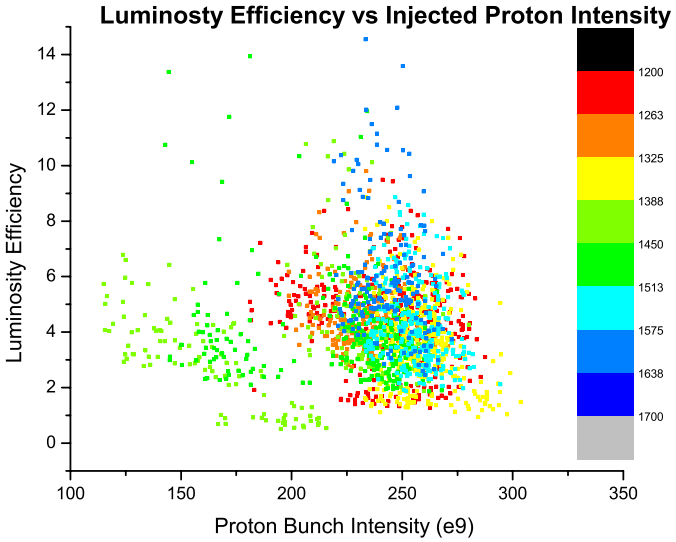
- Based on bunch intensity and emittance, compute a luminosity ("theoretical"). Quantity of interest: the ratio Rl between this predicted value and the measured Luminosity at CDF.
- Luminosity Efficiency: Basically the same thing, simply take the measured luminosity and divide by the average vertical emittance (pbar/proton) and the product of bunch intensity. (up to a presumably constant factor, 1.0/Rl)

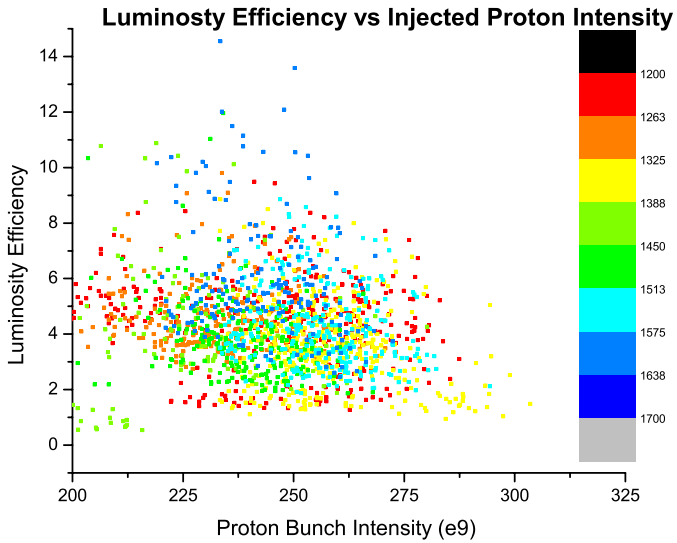
Ratio of Theoretical Lum. / CDF Lum.



Based on a b* at the I.P of 41 cm. Lattice value is 35.6 => We can/should rescaled upwards by 15% . We are still ~20% too low, in average.

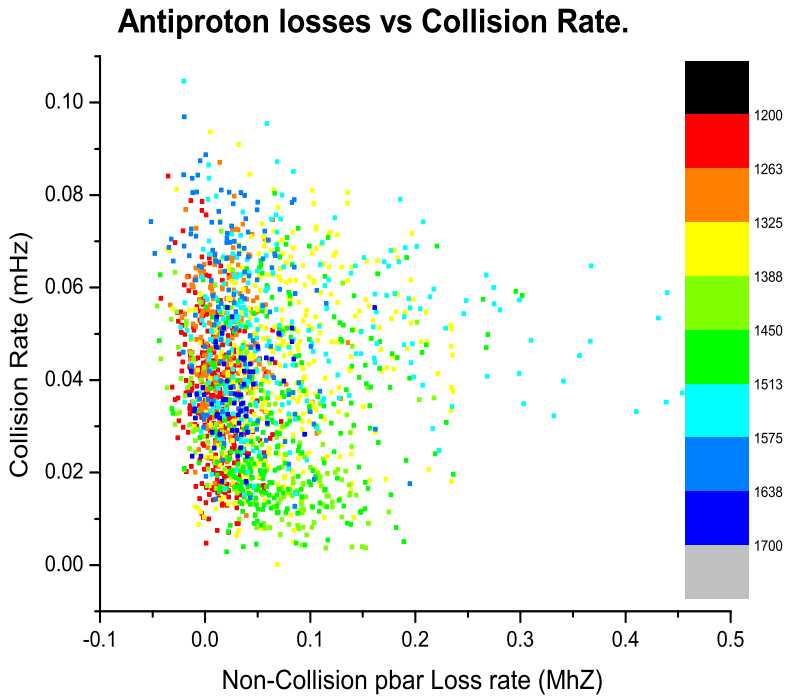
Luminosity Efficiency vs Injected Proton bunch Intensity/





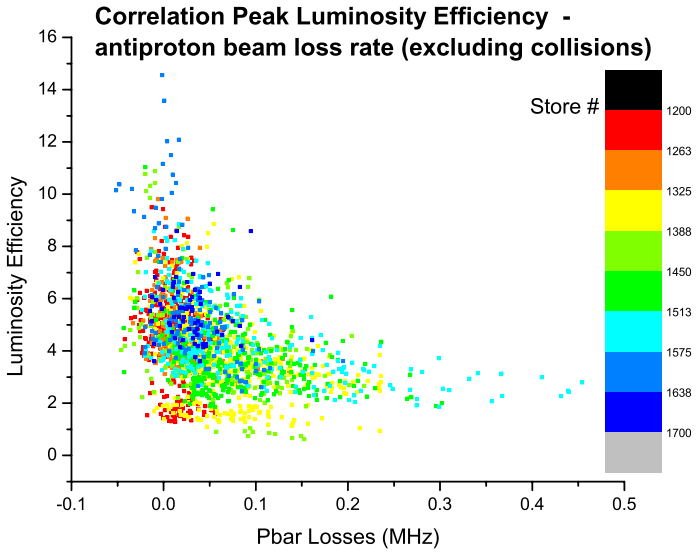
These two plots are based on the same sample of 2029 bunches within ~80 recent stores. The upper envelope at high intensity and high efficiency seems parabolic => to make good use of the beams, keep the proton intensity low… (***for now***)

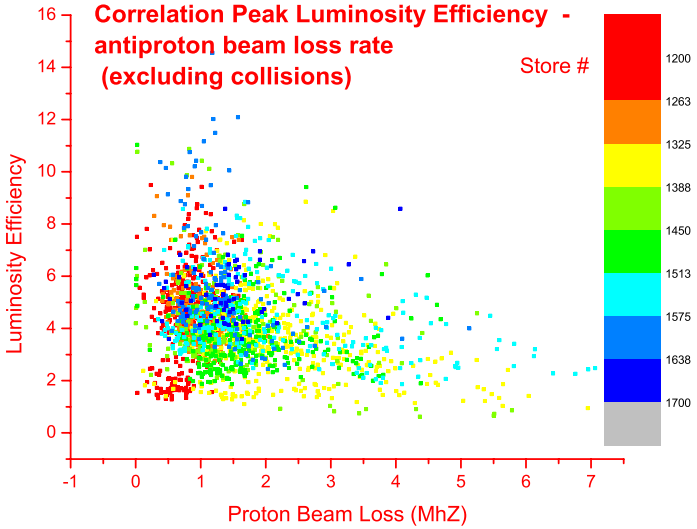
Do we use the costly pbar effectively? Collision Rate vs beam losses



Pbar beam losses:
We measure the pbar lifetime for the first 2.5 hours of the store. From this, we get a pbar dissapearance rate.
We subtract the collision rate, based on the peak luminosity.
We then have a measure of the pbar "waste" (collision free beam loss)

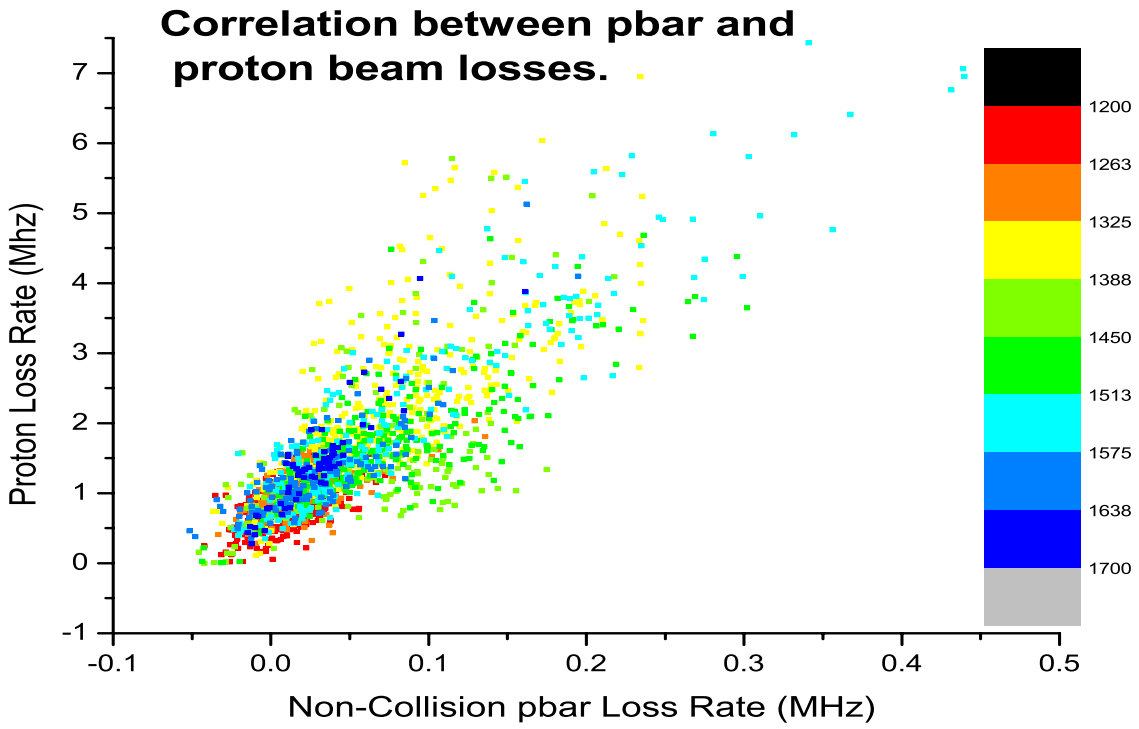
Luminosity Efficiency vs Wasted Beams





Again, collision rate have been subtracted. The silver lining in this:
If we don't waste the pbar during the store, the Luminosity Efficiency at the beginning of the store was high. This seems to indicate that, if we don't collide well, the pbar will diffuse and get lost.

Both (p, pbar) beam losses are correlated.



Conclusion (obvious).

- We need to find out what makes some bunch collide more efficiently than other.
- This will also reduce background.
- Unwise to increase proton intensity until we find we control these beams a bit better.